A BI-MODAL DISTRIBUTION OF ALHA77307 MATRIX OLIVINE: EVIDENCE FOR FINE-GRAINED MIXING FROM MULTIPLE RESERVOIRS IN THE CO FORMATION ZONE.

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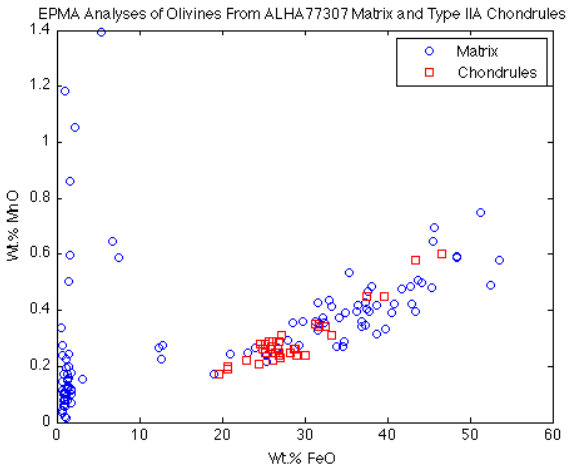
Introduction: The CO 3.0 chondrite ALHA77307 is thought to be the least metamorphosed of all the CO chondrites [1]. As such, the fine-grained (<30 μm) olivine found in its matrix is a valuable resource for investigating the CO formation environment since its compositions should be primary. In the CO matrix, we indeed find a wide range of major element compositions ($Fa_{0.5\text{-}71}$). However, more importantly, we find that the olivines make up two compositionally distinct populations ($Fa_{0.5\text{-}5}$ and $Fa_{21\text{-}71}$). Grains from both populations are found within an extremely close proximity and we see no obvious evidence of two distinct lithologies within our samples. Therefore, we conclude that the olivine grains found in the ALHA77307 matrix must have crystallized within two unique formation conditions and were later mixed at a very fine scale during the accretion epoch. Here, we propose a possible explanation based on Cr and Mn concentrations in the olivine.

The $Fa_{21\text{-}71}$ Reservoir: We propose that this population consists of fragmental chondrules. We obtained 35 EPMA measurements of olivine found in type IIA chondrules from ALHA77307, which exhibit remarkable compositional similarities to the $Fa_{21\text{-}71}$ found in matrix. Both groups of olivines begin at around 20 wt.% FeO and their Mn/Fe trends are nearly identical *(see figure below)*. Although the Cr content in the matrix grains is lower and not positively correlated with FeO like in the chondrules, mild metamorphic effects could explain this. Cr is more mobile and will respond faster to metamorphism in smaller grains, dropping to lower values [2].



$Fa_{0.5\text{-}5}$: It has been suggested that very low FeO olivines enriched in Mn could have condensed from the solar nebula [3]. As shown, many of our grains in this population are indeed enriched in MnO. However, we note that an elevated amount of MnO is not a requirement for forsterite to have condensed from a gas and suggest that the majority of this population has such an origin.

References:

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